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EXAMINER	
FETZNER, TIFFANY A	
ART UNIT	**PAPER NUMBER**
2859	

DATE MAILED: 09/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

ATC

Office Action Summary	Application No.	Applicant(s)	
	10/707,433	PETERS, ROBERT D.	
	Examiner	Art Unit	
	Tiffany A. Fetzner	2859	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 12 December 2003.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-14,16-22 and 24-26 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-14,16-22 and 24-26 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 28 March 2005 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED FINAL ACTION

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on 12/22/2003 was in compliance with the provisions of 37 CFR 1.97. Accordingly, as noted in the previous June 10th 2005 office action, the examiner has already considered the information disclosure statement of 12/22/2003. [The initialed and dated IDS was previously attached the previous June 10th 2005 office action].

Drawings

2. The Official Draftsperson has already approved the drawings filed 03/28/2005 as noted in the previous June 10th 2005 office action.

Response to Arguments

3. Applicant's arguments see the Remarks, filed 06/27/2005, with respect to **Liu et al., US patent 5,621,321** have been fully considered and are persuasive. Therefore, the earlier rejections of June 10th 2005 based on the prior art reference of **Liu et al.,** has been withdrawn.

4. The Applicant's arguments see the Remarks, filed 06/27/2005, with respect to **Sandford et al**., US patent 5,451,867 have been fully considered but they are **not persuasive**. Applicant argues on page 11 in paragraph 1 of the 06/27/2005 amendment remarks that "**Sandford et al**., discloses an imaging technique that amplifies the NMR signal for improved SNR and normalizes the amplified signal to account for amplification." And then argues that "One skilled in the art would readily appreciate such a technique does not correct acquired MR data for amplitude modulation effects present in a fast spin echo sequence used to acquire MR data". However, the examiner is not persuaded by this argument because in **Sandford et al**., the receiver gain is dynamically adjusted during the scan (i.e. during the acquisition of the MR data) to optimize the SNR of each received signal, at a particular receiver setting determined by a specific scan parameter, and one of the parameters taught by **Sandford et al**., is the phase encoding magnetic field gradient amplitude. [See **Sandford et al**., col. 2 lines 3-19]

5. **Sandford et al**., also teaches in col. 5 lines 3-7 that the digital attenuation signal applied to the receiver during the scan is changed so that NMR signals of widely varying amplitude can be acquired. The "widely varying" amplitudes received during acquisition of the received signals represent, and directly suggest, the applicant's claimed limitation of "amplitude modulation effects", to which applicant's instant application is drawn, as being present within a **Sandford et al**., pulse sequence generated by the **Sandford et al**., pulse generator module 121 and the **Sandford et al**., system control 122 [See col. 3 lines 6-32] The examiner notes that because **Sandford et al**., discloses the use of a pulse sequence, for the acquisition of "widely varying" detectable signal amplitudes of improved SNR, [See col. 5 lines 5-7] without specifying the type of pulse sequence, that the **Sandford et al**., reference broadly includes within its scope the application of "any" type of pulse sequence desired, [See col. 3 lines 6-18] in order to "acquire MR data". Additionally, because the acquisition/detection of an MR data signals with "widely varying" amplitudes is/are performed by one or more receivers, which are then adjusted to correct and normalize the signal amplitudes; The **Sandford et al**., reference, does suggest contrary to applicant's argument, that step of correcting the acquired MR data for "amplitude modulation effects" (i.e. widely varying amplitudes) present in a desired pulse sequence (i.e. an FSE or fast spin echo pulse sequence is considered to be a type of desired pulse sequence) that is "used to acquire MR data". Therefore, the earlier rejections of June 10th 2005 based on the prior art reference of **Sandford et al**., as a single reference are maintained.

6. In view of applicant's amendments to the claims filed 06/27/2005, the new rejections of the amended pending claims with the currently applied prior arts of **Sandford et al**., in view of the **Le Roux et al**., article "Stabilization of Echo Amplitudes is FSE Sequences" Magnetic Resonance in Medicine volume 30 1993 pages 183-191; (hereafter **Le Roux et al**., article), that are set forth below are made **final**.

7. The earlier rejections of June 10th 2005 based on the prior art references of **Liu et al.,** and **Sandford et al**., combined have been withdrawn.

8. Applicant's arguments, see the Remarks, filed 03/24/2005, with respect to **Kuhara** have been fully considered and are persuasive. The earlier rejections based on the prior art reference of **Kuhara** has been withdrawn.

9. All of the other rejections set forth below have been necessitated in view of applicant's amendments to the claims which necessitated the application of new art, (i.e. the **Le Roux et al.**, article), and also caused new objections to currently amended **claims 1-10** to be raised. Therefore a **final rejection** is proper.

Claim Objections

10. **Claims 1-10** are objected to because of the following informalities:

11. Applicant's **claims 1-10** are objected to because applicant has altered the scope of these claims, from what was originally presented for examination. The examiner notes that applicant argues that the replacing of MR data with k-space data better explains the invention of claims 1-10. However, these two terms contrary to applicant's arguments in the June 27th 2005 amendment and response are not equivalent. The term "**k-space data**" describes a general form of the acquisitional matrix array of the received MR echo data signal before the application of a Fourier Transformation which changes the data from the time/frequency domain of "k-space" with units of frequency, usually given in kHz or Hz to the image space, which produces MR images often used to diagnose a subject, object or patient. MR data refers to any type of detected MR signal regardless of whether the detected data is described as being in the time/frequency domain or the spatial/image domain. The examiner does not object to the use of the k-space terminology, but rather the removal of the "MR data" in combination with the addition of the "k-space" terminology since it is the removal of the "MR data" which has changed the scope of pending **amended claims 1-10**; and mandates an entirely new search for currently applicable prior art by the examiner, because without the MR data qualifier with respect to the 'k-space" terminology any image acquisition technique with acquires frequency or temporal image data becomes applicable to the claims, and applicant's original specification does not support an arbitrary frequency/temporal data arrays acquired from non-MRI technologies. The

broadening of the scope to include non-MRI technologies is considered to be new matter by the examiner.

12. In order to overcome this unsupported scope change/New matter objection, the examiner recommends applicant re-add the "MR data" terminology to **amended claims 1-10**, since the presence of the MR data with the k-space terminology is supported by applicant's original disclosure; and it is simply the deletion of the MR data feature / the absence of the MR data, (i.e. the claims specifying k-space data alone) that is not supported by applicant's original specification and raises the issue of new matter. Appropriate correction is required.

13. Since the objections have been caused by applicant's June 27th 2005 amendments to the claims. A final rejection is proper.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

16. **Amended Claims 1-8, 19-22,** and **24** are **finally rejected** under **35 U.S.C. 103(a)** as being unpatentable over **Le Roux et al**., article "Stabilization of Echo Amplitudes is FSE Sequences" Magnetic Resonance in Medicine volume 30 1993 pages 183-191. Hereafter **Le Roux et al**., article

17. With respect to **Amended Claim 1**, the **Le Roux et al**., article teaches and shows "A method comprising the steps of: acquiring ~~MR data~~ k-space data from multiple

echoes in an echo train with a fast spin echo pulse sequence;" [See **Le Roux et al.**, article page 183 abstract; page 188 "experimental verification section" through page 190; Figures 3 through 12]. The **Le Roux et al.**, article also teaches and shows "correcting <u>the acquired k-space data</u> for amplitude modulation effects" (i.e. the Stabilization process of the Echo Amplitudes described on pages 186 through 190 is the feature of "correcting for amplitude modulation effects" which is the problem taught by the **Le Roux et al.**, article in the introduction section on page 183. [See **Le Roux et al.**, article page 183] in the fast spin echo pulse sequence ~~after data acquisition~~" [See **Le Roux et al.**, article page 183 abstract; page 188 "experimental verification section" through page 190; Figures 3 through 12]; "<u>and 2D Fourier transforming the corrected k-space data to form an image space from which an image is reconstructed.</u> [See **Le Roux et al.**, article page 183 abstract; page 188 "experimental verification section" through page 190; especially page 188 col. 2 text line 2 and Figures 3 through 12, which show two dimensional data in figures 4, 5, and 11; and 2D/3D data in figures 6 through 9 and figure 12 depending on the frame of reference chosen by an individual of ordinary skill in the art.].

18. The **Le Roux et al.**, article lacks explicitly using the terms "k-space" or "k-space data", however as argued by applicant in the June 27th 2005 amendment and response the terms "k-space" and "k-space data" describe a matrix or array that is normally described as having a horizontal, slice or "kx" frequency location and a vertical or "ky" phase component located in frequency space prior to Fourier Transformation; In the **Le Roux et al.**, article figures 4 through 9, 11 and 12 directly suggest that each point of the shown 2D/3D curves, and each respective echo in the multi-echo train, are illustrated subsequently in normalized "k-space" and represent 'k-space" data. Additionally, the **Le Roux et al.**, article teaches on page 189 col. 1 paragraph 4 with respect to figures 8 and 9 that "the first echo is used for the acquisition of the line $\mathbf{k_2=0}$ (center-out echo-to-view ordering with a total of 256 phase encodings)". The line $\mathbf{k_2=0}$ is a direct suggestion of a "k-space" notation.

19. With respect to **Amended Claim 2**, the **Le Roux et al.**, article teaches and shows "the steps of: acquiring at least one set of reference ~~MR~~ <u>k-space</u> data;" (i.e. the

non phase-encoded data acquisition reference sequence used to correct errors in the imaging sequence with phase encoding.) [See the **Le Roux et al**., article Experimental verification page 188 col. 1-col. 2 where phase encoding is turned off. Figures 6, 7 and 12 also show slice profiles in k-space without phase encoding active. See pages 189-190] the **Le Roux et al**., article also teaches "determining a table of amplitude modulation correction values;" [See the pre-distortion curves of figure 2 on page 187 and page 187 col. 1 paragraph 2 where correction functions $s_i(S)$ are tabulated.] The Examiner notes that an array(s) of stored data (i.e. acquired signal data, and correction data for amplitude correction) in a 256 x 32 matrix is/are the computer memory version of a data table, as suggested by page 187 col. 1 paragraph 2 which represents at least one "table of amplitude modulation correction values" because fig. 2 shows the table of corrections. Additionally, the **Le Roux et al**., article teaches, "applying at least a portion of the table to the acquired k-space ~~MR~~ data." [See figure 5, which shows the result of the application of the stabilized corrections for the RF MR k-space data. Additionally with respect to the amended k-space terminology see the entire **Le Roux et al**., article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al**., article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claim 1** also apply to **claim 2** and need not be reiterated.

20. With respect to **Claim 3**, the **Le Roux et al**., article teaches "acquiring at least one set of reference ~~MR~~ k-space data before" [See figure 2 pages 187-188 where the pre-distortion curves or reference corrections are acquired before he experimental data] "and after acquisition of the ~~MR~~ k-space data" [See **Le Roux et al**., article page 190, and Figure 10 where in the modification to the invention, in subsequent pulses a new set of pre-distortion reference data curves are obtained.] Additionally with respect to the amended k-space terminology see the entire **Le Roux et al**., article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al**., article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claims 1, 2** also apply to **claim 3** and need not be reiterated.

21. With respect to **Amended Claim 4**, the **Le Roux et al**., article teaches "acquiring at least one set of reference ~~MR~~ k-space data before acquisition of the ~~MR~~ k-space data" [See page 187 col. 21 paragraph 2 through page 188 where initially a set of pre-distortion reference curves are calculated] "and acquiring a second portion" (i.e. Figure 10 which shows a new set of pre-distortion curves acquired, for the situation of relaxing the constraints on the first experimental pulse) "of the at least one set of reference ~~MR~~ k-space data" (i.e. the pre-distortion curves calculated with phase encoding off) "after acquisition of the ~~MR~~ k-space data" [See pages 187-190 where the acquisition of experimental data shown in figures 6 through 9 occurs after the pre-distortion curves of figure 2 are calculated, and before the new referential pre-distortion curves of figure 10 are calculated. col. 13 lines 57-59; col. 10 lines 63-67]

22. Additionally with respect to the amended k-space terminology see the entire **Le Roux et al**., article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al**., article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claims 1, 2, 3** also apply to **claim 4** and need not be reiterated.

23. With respect to **Claim 5**, the **Le Roux et al**., article teaches and shows that "at least one set of reference ~~MR~~ k-space data includes non-phase encoded data." (i.e. the data obtained with the phase encoding turned off.) [See the **Le Roux et al**., article Experimental Verification page 188 col. 1 through col. 2.] Additionally with respect to the amended k-space terminology see the entire **Le Roux et al**., article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al**., article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claims 1, 2** also apply to **claim 5** and need not be reiterated.

24. With respect to **Claim 6**, the **Le Roux et al**., article suggests from the equations of page 188 the step of "multiplying each signal profile" (i.e. each echo signal) "of the acquired ~~MR~~ k-space data by a correction value from a corresponding ky location in the table;" (i.e. the Pre-distortion tabulated data of figure 2 [See the **Le Roux et al**., article page 187 col. 1 paragraph 2 through col. 2 page 187 and figure 2.] and carrying out the

steps of multiplying" [See the equations on page 187] "prior to transformation" (i.e. via Fourier Transformation) "of the acquired ~~MR~~ k-space data from k-space to image space" (i.e. this limitation is equivalent to performing the correction before reconstructing an image.) [See the **Le Roux et al.**, article Design of selective pulses and Experimental Verification page 188 col. 1 through col. 2 where each pulse $\mathbf{s_i}$ is multiplied by a template function **S(u)** given by $\mathbf{s_i S(u)}$. See also figures 2, 3, 4, and 5.] Additionally with respect to the amended k-space terminology see the entire **Le Roux et al.**, article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al.**, article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claims 1, 2** also apply to **claim 6** and need not be reiterated.

25. With respect to **Claim 7**, the **Le Roux et al.**, article suggests and shows from the teachings and figures of pages 187 and 188 that the "at least one set of reference" (i.e. pre-distortion) "data includes two sets of reference data" because the **Le Roux et al.**, article shows more than 2 sets of pre-distortion reference curves in figures 2, 3, 4, and 5.] The **Le Roux et al.**, article also suggests, teaches and / or shows method steps "further comprising the steps of averaging the two sets of reference data" [See the teaching of performing a weighted least mean (i.e. average)-square of page 188 col. 1 paragraph 1] in order "to determine the table of correction values" [See figure 2 and the teachings on pages 187 and 188.] The same reasons for rejection, and obviousness that apply to **claims 1, 2** also apply to **claim 7** and need not be reiterated.

26. With respect to **Amended Claim 19**, the **Le Roux et al.**, article teaches and/or suggests "A computer readable storage medium" because in the MRI art computer method algorithms are conventionally stored within the implementing computer processor [See also the teachings concerning the algorithm(s) for implementing the **Le Roux et al.**, articles methodology found in the abstract, figures and text of pages 183-190 in combination figure 1 components 104, 110 and 112]

27. The **Le Roux et al.**, article intrinsically uses an algorithm "a computer program" (i.e. See the exemplary algorithms mentioned on page 188 col. 1 paragraph 1 of the **Le Roux et al.**, article) which are used with the **Le Roux et al.**, article teachings "to

execute a fast Spin echo pulse sequence stored thereon and representing a set of instructions that when executed by a computer causes the computer to: acquire non-phase encoded MR data;" [See the **Le Roux et al**., article page 188 col. 1 paragraph 2 where during the FSE (i.e. fast spin echo pulse sequence) the phase-encoding is turned off] "acquire phase encoded data from the multiple echoes; [See page 184 col. 2 "result 2" paragraph through page 190 where figures 8 and 9 which show examples of phase-encoded acquisition, while figure 6 and 7 show the acquisition of multiple echo signals with phase encoding off, Figures 6 and 8 correspond; as do figures 7 and 9 with the difference being the absence or presence of the phase encoding.]

28. The **Le Roux et al**., article also teaches generating "a set of amplitude correction values from the non-phase encoded MR data; [See the **Le Roux et al**., article teachings of page 188 in combination with figures 2, 3, 4, and 5] "arranging the set of amplitude correction values in a table dimensionally equivalent to a k-space" (i.e. the line k_2=0 on page 189 of the view-ordering suggests k-space) "of the phase-encoded MR data;" [See Figures 8 and 9; and page 187 col. 1 paragraph 2 where an array (i.e. a suggestive k-space array) with the dimensions of 256 x 32 is taught, which is equivalent to the dimensions shown in figures 8 and 9 on page 189.] and" the **Le Roux et al**., article shows and suggests the ability to "modify the phase encoded MR data by the non-phase encoded MR data to correct amplitude modulation between the multiple echoes by modifying each data point of k-space with a similarly positioned amplitude correction value." [See figures 2 through 9 and the teachings on page 187 through 190; page 189 col. 1 paragraph 4 where each sub slice in the figures is shown separately. Figure 6 is equivalent to figure 8 without phase-encoding, figure 7 is equivalent to figure 9 without phase-encoding. Also page 187 col. 2 in the middle of the paragraph under equation 20 teaches that in a selective pulse experiment, the same change of phase reference can be done individually for each sub slice, independent of every other sub slice.

29. The Examiner also notes that an array, or arrays of stored data (i.e. acquired signal data, and correction data for amplitude and phase correction) is/are equivalent to the computer memory version of one or more data tables, that as suggested by figures 4, 7, and 9, comprises at least one "table / set of amplitude modulation correction

values". Additionally with respect to the amended k-space terminology see the entire **Le Roux et al.**, article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al.**, article teaches, lacks and suggests with respect to the "k-space", and "k-space data" terminology.

30. The **Le Roux et al.**, article lacks directly teaching explicitly that the MRI data and methodology taught in this article is specifically implemented on a "computer'. However, It would have been obvious to one of ordinary skill in the art at the time that the invention was made that the presence of an MRI system with an MRI implementing computer processor is an aspect within the scope of the **Le Roux et al.**, article because the use of a computer to implement an MRI pulse sequence and perform the Fourier Transformation required for the final image reconstruction is conventionally well-known in the art, and considered an intrinsic aspect to the **Le Roux et al.**, article, since the calculations required are to numerous to be performed by hand and necessitate the use of some type of computer processor for implementation. The same reasons for rejection, and obviousness that apply to **claims 1,** also apply to **claim 19** and need not be reiterated.

31. With respect to **Amended Claim 8**, and **corresponding claim 22** which respectively depend from **claims 1**, and **19** the **Le Roux et al.**, article suggests and shows from the teachings and figures of pages 187 and 188 that **"**the at least one set of reference" (i.e. pre-distortion) "data represents a maximum achievable signal" (i.e. FWHM) "that the acquired phase encoded ~~MR~~ k-space data can attain". [See page 187 col. 1 paragraph 2 through page 190; figures 2 through 12.] Additionally with respect to the amended k-space terminology see the entire **Le Roux et al.**, article, and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al.**, article teaches and lacks with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, and obviousness that apply to **claims 1, 2, 5, 19,** also apply to **claims 8, 22** and need not be reiterated.

32. With respect to **Claim 20**, the **Le Roux et al.**, article teaches "acquiring the non-phase encoded MR data" [See figures 6 and 7] "from a series of discarded acquisitions played out **at least one of before and after** acquisition of the phase encoded MR

data". [See the **Le Roux et al.**, article figures 8 and 9 pages 188 through 190, which are acquired after the data for figures 6 and 7.] The same reasons for rejection, and obviousness that apply to **claim 19** also apply to **claim 20** and need not be reiterated.

33. With respect to **Claim 21**, the **Le Roux et al.**, article teaches and/or shows that "the phase encoded data includes one of 2D and 3D MR data" because 2D planar slices, or 3D volumetric slab images are produced. [See the **Le Roux et al.**, article figures 6, 7, 8, 9, and 13.] The same reasons for rejection, and obviousness that apply to **claim 19** also apply to **claim 21** and need not be reiterated.

34. With respect to **Claim 24,** the **Le Roux et al.**, article lacks directly teaching the step of "amplitude correcting acquired phased encoded MR data without increasing scan time". However, figures 6, 7, 8, and 9 each show experimental profiles collected with the same scan time, and figure 9 of the **Le Roux et al.**, article shows that the amplitude stabilization with phase encoding is also obtainable in the same time span of signal acquisition as the non-stabilized signals of figure 8 which are also phase encoded. Therefore, even though the **Le Roux et al.**, article lacks directly teaching the verbatim step of "amplitude correcting acquired phased encoded MR data without increasing scan time", It would have been obvious to one of ordinary skill in the art at the time that the invention was made that this limitation is directly suggested from a comparison of figures 6, 7, 8 and 9.The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 19** also apply to **claim 24** and need not be reiterated.

35. **Claims 1, 9-14, 16-19, 25** and **26** are **finally rejected** under **35 U.S.C. 103(a)** as being unpatentable over **Sandford et al.,** US patent 5451876 issued September 19th 1995. This patent has an equivalent in German (i.e. DE 4436801 A1 published 20th April 1995); in view of the **Le Roux et al.**, article "Stabilization of Echo Amplitudes is FSE Sequences" <u>Magnetic Resonance in Medicine</u> volume 30 1993 pages 183-191. Hereafter **Le Roux et al.**, article.

36. With respect to **Amended Claim 1**, **Sandford et al.,** teaches and shows "A method comprising the steps of: acquiring ~~MR~~ <u>k-space</u> data from multiple echoes in an echo train with a pulse sequence;" [See **Sandford et al.**, col. 3 lines 42-58 the detailed

description paragraph which starts with the text "a transceiver module 150 ...] **Sandford et al.,** also teaches and shows "correcting the acquired k-space data for amplitude modulation effects in the pulse sequence" [See **Sandford et al.,** col. 2 lines 3-52 and the entire detailed description] "and 2D Fourier transforming the corrected k-space data to form an image space from which an image is reconstructed." [See **Sandford et al.,** col. 5 lines 18-60, where the use of a Fourier Transform to produce an image denotes a 2D or two dimensional Fourier Transformation because images are conventionally two-dimensional unless otherwise stated, and in the first **Sandford et al**., embodiment the Fourier transform is applied after the amplitude and phase corrections to the pulse sequence.]

37. **Sandford et al**., lacks directly teaching the term "k-space", or "K-space data" explicitly, however figures 3a and 3b which show a two-dimensional or three dimensional data array, or matrix table are also suggestive of the "k-space" in which the detected signal data, in memory module 160, is located after being acquired by transceiver 150, and operated on by CPU module 119 to correct / normalize / stabilize the amplitude values, before being Fourier transformed in the array processor 161. [See **Sandford et al**., figures 3a, 3b, 1 and col. 5 lines 34-60] The examiner also notes that MR signal data that is defined in the time domain prior to Fourier Transformation is also directly suggestive of "k-space", and / or the "K-space data" terminology even if not directly recited verbatim within a reference. Additionally, the **Le Roux et al**., article also suggests the "k-space", or "K-space data" terminology from the earlier rejection of claim 1 by the **Le Roux et al**., article which need not be reiterated. It would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teachings of **Sandford et al**., with the teachings of the **Le Roux et al**., article which also teach/suggest the use of k-space and k-space data terminology when more than one individual slice image, indexed by table component 225, is to be calculated, because the terminology helps each slice to be independently identified.

38. **Sandford et al**., also lacks directly teaching the use of "a fast spin echo pulse sequence." However, the **Le Roux et al**., article teaches "a fast spin echo pulse sequence." [See the **Le Roux et al**., article page 188 the Experimental Verification

section]. Additionally the **Le Roux et al**., article teaches correcting both amplitude and phase components throughout the reference, [See the **Le Roux et al**., article page 186, the Stabilization of echo amplitudes section through 190]. It would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teaching of **Sandford et al**., which corrects the amplitude modulations of a desired pulse sequence from a plurality of signals which may be from one or a plurality of independent receiver coils, with the teachings of the **Le Roux et al**., article which specifically teaches the ability to correct echo amplitudes in a fast-spin-echo pulse sequence when an FSE sequence is the desirable sequence to be performed, because the **Le Roux et al**., article is specifically designed to address amplitude modulation corrections within a CPMG, an FSE, or a RARE pulse sequence. [See the **Le Roux et al**., article abstract].

39. With respect to **Amended Claim 9**, **Sandford et al**., teaches that "the ~~MR~~ k-space data is acquired via multiple receiver coils, (i.e. a plurality) "of receiver coils" [See **Sandford et al**., col. 6 lines 55-59 which starts with the text "It should be apparent to those skilled in the art that when a plurality of receivers ..."] "and further comprising the steps of correcting for amplitude modulation effects in the MR data from each receiver coil independently." [See the **Sandford et al**., col. 6 lines 55-59] Additionally with respect to the amended k-space terminology see the same teachings as recited in the **rejections of claim 1** above concerning with respect to the "k-space", and "k-space data" terminology, what each of the **Sandford et al**., and **Le Roux et al**., article references teach and lack with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, obviousness, and motivation to combine, that apply to amended **claim 1** also apply to amended **claim 9** and need not be reiterated.

40. With respect to **Claim 10**, **Sandford et al**., teaches, "generating a combined image from corrected image data from each receiver coil." [See **Sandford et al**., col. 4 lines 47-63; col. 6 line 60 through col. 7 line 24. See also the **Sandford et al**., abstract where all the received corrected signals are used to reconstruct an image, and **Sandford et al**., col. 6 lines 55-59 through col. 7 line 21 where a single image or a plurality of images may be formed]. The same reasons for rejection, obviousness, and

motivation to combine, that apply to **claims 1, 9** also apply to **claim 10** and need not be reiterated.

41. With respect to **Amended Claim 11**, **Sandford et al**., teaches and shows "An MRI apparatus comprising: a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images", [See **Sandford et al**., figure 1, col. 1 line 1 through the entire detailed description] "and a computer" (i.e. computer system 107) "programmed to: (A) acquire at least one set of reference MR data;" (i.e. the MR data without phase encoding) "(B) determine a table of amplitude modulation correction values from the reference MR data;" [See **Sandford et al**., col. 1 line 1 through the entire detailed description. The examiner notes that constructing a table of amplitude correction values is a main point of the entire reference.]

42. Additionally, the examiner notes that **Sandford et al**., teaches that the receivers not only change the amplitude of the acquired NMR signal, but also the time delay imposed on the acquired NMR signal which must be normalized to remove smearing, blurring or the misplacement of spin signals along the readout gradient axis. [See **Sandford et al**., col. 5 lines 25-32, where the correction of the "time delay" which removes smearing, blurring or the misplacement of spin signals along the readout gradient axis, <u>is</u> a "modulation correction", and the correction parameters "A" and (θ) stored in normalization table 225 are amplitude "A", "modulation correction" θ values. [See col. 5 line 25 through col. 8 line 11] The examiner also points out that the amplitude modulation corrections of applicant's specification remove smearing, blurring or the misplacement of spin signals, therefore the table of correction values "A", "θ" directly meet the requirements of the claim as supported by applicant's original disclosure in contrast to the arguments of the March 24th 2005 response.

43. The **Sandford et al**., reference also teaches limitation "(C) acquire MR data;" [See col. 2 lines 12-15] "and (D) modify the acquired ~~set of reference~~ MR data <u>while the</u>

MR data is entirely in k-space (i.e. correcting the data before application of a Fourier Transformation) [See **Sandford et al**., col. 5 lines 34-60] "by the table of amplitude modulation correction values". [See **Sandford et al**., col. 1 line 1 through the entire detailed description. The examiner notes that constructing a table of amplitude correction values, and correcting the amplitude and time delays in order to remove the amplitude modulation problems of smearing, blurring or the misplacement of spin signals along the readout gradient axis is a main point of the entire reference.]

44. The **Sandford et al**., reference lacks teaching the acquisition of MR data occurs with a fast spin echo pulse sequence or the table of correction values specifically accounts for amplitude modulation effects in a fast spin-echo pulse sequence played out to acquire the MR data." However, the **Le Roux et al**., article teaches "a fast spin echo pulse sequence." [See the **Le Roux et al**., article abstract, page 188 Experimental verification] Additionally the **Le Roux et al**., article teaches correcting both amplitude and phase components throughout the reference, [See the **Le Roux et al**., article pages 186 through 190, figures 2 through 12] It would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teaching of **Sandford et al**., which corrects the amplitude modulations of a plurality of signals from one or a plurality of independent receiver coils, with the teaching of the **Le Roux et al**., article which specifically teaches the ability to correct echo amplitudes in a fast-spin-echo pulse sequence when an FSE sequence is the desirable sequence to be performed, because the **Le Roux et al**., article is specifically designed to address amplitude modulation corrections within a CPMG, an FSE, or a RARE pulse sequence. [See the **Le Roux et al**., article abstract].

45. Additionally with respect to the amended k-space terminology see the same teachings as recited in the **rejections of claim 1** above concerning with respect to the "k-space", and "k-space data" terminology, what each of the **Sandford et al**., and **Le Roux et al**., article references teach and lack with respect to the "k-space", and "k-space data" terminology.

46. With respect to **Claim 12**, **Sandford et al**., teaches "acquiring the at least one set of reference MR data from one or more discarded acquisitions played out one of

prior to and after acquisition of the MR data". [See **Sandford et al**., Figure 4 and col. 6 line 60 through col. 8 line 11.] The same reasons for rejection, obviousness, and motivation to combine, that apply to claim **11** also apply to **claim 12** and need not be reiterated.

47. With respect to **Claim 13**, **Sandford et al**., teaches "acquiring portions of the at least one set of reference MR data prior to and after acquisition of the MR data". [See **Sandford et al**., Figure 4 and col. 6 line 60 through col. 8 line 11.] The same reasons for rejection, obviousness, and motivation to combine, that apply to claim **11** also apply to **claim 13** and need not be reiterated.

48. With respect to Amended **Claim 14**, **Sandford et al**., teaches that "the at least one set of reference MR data includes non-phase encoded data" [See **Sandford et al**., col. 7 line 25 through col. 8 line 11 "The table of receiver attenuation values (RA used during the scan can be produced in a number of ways ..." through the end of the detailed description] **Sandford et al**., teaches that "the MR acquired ~~MR~~ data is modified while in k-space" because the amplitude correction occurs prior to the Fourier Transformation which produces the final resulting image(s). [See the entire **Sandford et al**., detailed description.] The examiner notes that any step, which occurs prior to the image producing Fourier Transform, occurs necessarily in the intrinsic k-space domain. Additionally with respect to the amended k-space terminology see the same teachings as recited in the **rejections of claim 1** above concerning with respect to the "k-space", and "k-space data" terminology, what each of the **Sandford et al**., and **Le Roux et al**., article references teach and lack with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, obviousness, and motivation to combine, that apply to claim **11** also apply to **claim 14** and need not be reiterated.

49. 16. With respect to **Claim 16**, **Sandford et al**., teaches that "the RF coil assembly includes a phased array" (i.e. a plurality) "of receiver coils" [See **Sandford et al**., col. 6 lines 55-59, which starts with the text "It should be apparent to those skilled in the art that when a plurality of receivers ... as with phase array receive coil. ..."] . The same reasons for rejection, obviousness, and motivation to combine, that apply to claim **11** also apply to **claim 16** and need not be reiterated.

50. With respect to **Claim 17**, **Sandford et al.**, teaches that "the computer is further programmed to carry out acts (A)-(D) independently for each receiver coil" [See **Sandford et al.**, col. 4 lines 37-46 which starts with the text "Referring particularly to figures 1 and 2, ... the coils 152A, 152B may be separate as shown in fig. 2, ..." and col. 6 lines 55-59, that begins with "It should be apparent to those skilled in the art that when a plurality of receivers ... as with phase array receive coil. ..." through the end of the detailed description]. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 11, 16** also apply to **claim 17** and need not be reiterated.

51. With respect to **Claim 18**, **Sandford et al.**, teaches generating "an image space from the modified MR data." [See **Sandford et al.**, col. 4 lines 47-63 which starts with the text "The received signal ..." detailed description paragraph 20 which starts with the text "Referring particularly to figure 4 ..." and detailed description paragraph 21 which starts with the text "After the pre-scan 230, and ..."]. The same reasons for rejection, obviousness, and motivation to combine, that apply to claim **11** also apply to **claim 18** and need not be reiterated.

52. With respect to **Amended Claim 19**, **Sandford et al.**, teaches and/or suggests "A computer readable storage medium" [See figure 1 components 111, and 112, memory module 160; along with the taught/shown computer programs which can be hardware or software; col. 2 line 56 through col. 3 col. 3 line 5; col. 6 lines 60-62.] **Sandford et al.**, teaches "a computer program" (i.e. the CPU module program) taught in col. 6 lines 60-62) which are used "to execute a desired pulse sequence stored thereon and representing a set of instructions that when executed by a computer causes the computer to: acquire non-phase encoded MR data;" [See **Sandford et al.**, col. 7 lines 27-28 where executing the pulse sequence without phase encoding is taught.] "acquire phase encoded data from the multiple echoes; [See col. 2 lines 15-40; col. 5 line 34 through col. 8 line 11]

53. **Sandford et al.**, also teaches generating "<u>a set of amplitude correction values from the non-phase encoded MR data;</u> [See col. 5 line 34 through col. 8 line 11] The step of "<u>arranging the set of amplitude correction values in a table dimensionally</u>

equivalent to a k-space of the phase-encoded MR data;" [See Figures 3a and 3b, which show arrays with equivalent dimensions for containing the amplitude and phase correction values.] Additionally, **Sandford et al.**, suggests the ability to "modify the phase encoded MR data by the non-phase encoded MR data to correct amplitude modulation between the multiple echoes by modifying each data point of k-space with a similarly positioned amplitude correction value." [See col. 7 line 25 through col. 8 line 11.] Additionally with respect to the amended k-space terminology see the entire **Sandford et al.**, **al.**, reference and the **rejection of claim 1** above concerning the teachings that the **Le Roux et al.**, article teaches, lacks and suggests with respect to the "k-space", and "k-space data" terminology. The same reasons for rejection, obviousness, and motivation to combine, that apply to **claims 1,** also apply to **claim 19** and need not be reiterated.

54. With respect to **Claim 25**, **Sandford et al.**, **al.**, teaches and/or shows "carrying out a pre-scan of a subject" [See **Sandford et al.**, **al.**, col. 6 line 63 through col. 7 line 13] "and acquire the non-phase encoded MR data after the pre-scan but before acquisition of the phase encoded MR data. [See **Sandford et al.**, **al.**, col. 7 line 25 through col. 8 line 11] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 19** also apply to **claim 25** and need not be reiterated.

55. With respect to **Claim 26**, **Sandford et al.**, **al.**, shows from the connection lines which connect the components of figures 1and 2 in combination with the teachings of col. 4 lines 5-67 that the "computer data signal" is "embodied in a carrier wave that is uploadable/downloadable to an MR imaging system." [See **Sandford et al.**, **al.**, figures 1, 2 and col. 4 lines 5-67.] The same reasons for rejection, obviousness, and motivation to combine, that apply to **claim 19** also apply to **claim 26** and need not be reiterated.

56. **Amended Claim 1** is rejected under **35 U.S.C. 103(a)** as being unpatentable over **Le Roux et al.**, US patent 5,345,176 issued September 6th 1994; Hereafter the **Le Roux et al.**, patent, (i.e. which is the corresponding patent of the **Le Roux et al.**, article "Stabilization of Echo Amplitudes is FSE Sequences" Magnetic Resonance in Medicine volume 30 1993 pages 183-191.)

57. With respect to **Amended Claim 1**, the **Le Roux et al.**, patent teaches and shows "A method comprising the steps of: acquiring ~~MR data~~ k-space data from multiple echoes in an echo train with a fast spin echo pulse sequence;" [See **Le Roux et al.**, abstract; col. 1 lie 13 through col. 11]. The **Le Roux et al.**, patent also teaches and shows "correcting the acquired k-space data for amplitude modulation effects" (i.e. the Stabilization process of the Echo Amplitudes described in col. 3 line 10 through col. 11, is the feature of "correcting for amplitude modulation effects" which is the problem taught by the **Le Roux et al.**, patent col. 1 line 13 through col. 3 line 7. [See **Le Roux et al.**, patent col. 1 line 13 through col. 3 line 7] "in the fast spin echo pulse sequence" ~~after data acquisition~~ [See **Le Roux et al.**, patent figure 3 col. 3 line 10 through col. 11]; "and 2D Fourier transforming the corrected k-space data to form an image space from which an image is reconstructed. [See **Le Roux et al.**, patent col. 6 line 60 through col. 11]

58. The **Le Roux et al.**, patent lacks explicitly using the terms "k-space" or "k-space data", however as argued by applicant in the June 27th 2005 amendment and response the terms "k-space" and "k-space data" describe a matrix or array that is normally described as having a horizontal, slice or "kx" frequency location and a vertical or "ky" phase component located in frequency space prior to Fourier Transformation; figure 6 directly suggests that each point of the shown 2D/3D curves, and each respective echo in the multi-echo train, are illustrated in "k-space" and subsequently represent 'k-space" data. Additionally the fact that the computer system is provided with a means to store "raw" (i.e. k-space) data before image construction also is suggestive that both MR k-space and MR k-space data are aspects of the **Le Roux et al.**, patent.

Prior Art of Record

59. The **prior art made of record** and not relied upon (i.e. See the attached PTO 892) is considered pertinent to applicant's disclosure.

A) **Kuhara** US patent 4,859,946 issued August 22nd 1989.

B) **Maier et al.,** German DE patent 4436801 A1 published 20th April 1995, which is equivalent to **Sandford et al.**, US patent 5451876 issued September 19th 1995.

C) **Zhang** US patent application publication 2003/0109781 A1 published June 12th 2003, filed December 11th 2001.

D) **Satoh** US patent 4,746,860 issued May 24th 1988.

E) **Ma et al.,** US patent 6,586,935 B1 issued July 1st 2003, filed May 31st 2000.

F) **Satoh** US patent 4,999,581 issued March 12th 1991.

G) **Zhou et al.,** US patent 6.064205 issued May 16th 2000.

H) **Zhou et al.,** US patent 5,923,168 issued July 13th 1999.

I) **Zhou et al.,** US patent 5,672,969 issued September 30th 1997.

J) ***Le Roux et al**., US patent 5,315,249 issued May 24th 1994;

K) **Liu et al.,** US patent 5,621,321 issued April 15th 1997.

60. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

61. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Conclusion

62. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

63. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.

Tiffany A. Fetzner
TAF
September 24, 2005

Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800